OAT Report

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Compare the results [of space-filling vs grid-search]; which method is more efficient?
Plugging in different parameters and stopping conditions, it appears that it is fairly arbitrary as to which method performs better. Overall, both functions perform similarly and neither was noticeably better than the other. However, grid search is arguably more consistent and easier to implement.

By comparing your plot of the univariate function fog with a plot of the bivariate function f, explain which problem is easier to solve.
f is much easier to solve, as it is a convex function. fog is not convex, with many local minima, and is therefore much more difficult to solve directly. We have created a difficult problem from an easy one.

Considering that the minimum of the univariate function is computed by brute force, explain whether it is a good idea to compute the convex envelope.
Computing the minimum of the univariate function by brute force takes O(n). Computing the convex envelope also takes O(n), so there's no point in doing the extra step. Furthermore, each iteration of the convex envelope calculation is much more computationally intense, causing it to be even less performant.

Comment your numerical results comparing the space-filling method with the brute force grid search method. Which one performs best? Make sure your numerical experiments support your conclusion.
In the worst case, grid-search does worse. In an arbitrary case, neither function performs better on average. In fact, our testing showed that changes to the min location or stopping condition caused either function to suddenly become much better or much worse than the other. See main.m for experiments and results.

Table 1: comparison most efficient algorithm based on parameter choice.

	Min loc 1	**Min loc 2**
Small Epsilon	Grid search	Space-filling
Large Epsilon	Space-filling	Equal

Table 2: number of function evaluations based on parameter choice

Epsilon	Min Loc	Grid Search Evals	Space-Filling Evals
0.01	Loc 1	65536	16384
0.01	Loc 2	16384	16384
0.001	Loc 1	65536	131072
0.001	Loc 2	1048576	524288

In which case will you use the space-filling method?
The space-filling function has a tendency to poll more points along the extremes of the region (high and low values of the cos curve), and therefore may be more efficient than grid search in cases where you know your minimum location is more likely to be in those regions.