

This is a sample Lab assignment for Calc III. It is based on a Calc I style optimization problem, and this is intended to show examples of “good” and “bad” lab write-ups. Adapted from Brief Applied Calculus by Berresford and Rockett.

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To celebrate the acquisition of Styria in 1261, Ottokar II sent hunters into the Bohemian woods to capture a unicorn. To display the unicorn at court, the King wants to build a rectangular cage. The material for the three sides of the cage cost 3 ducats per running cubit, while the fourth wall was to be gilded (covered in gold) and cost 51 ducats per running cubit.

In 1261, it was well known that a happy unicorn requires an area of 2500 square cubits. Of course, the King wanted to build a cage that would keep the unicorn happy, but not cost him his whole kingdom!

1. Draw a picture of the cage and define some variables to be the lengths of the unknown sides.
2. Intuitively, what shape will the cage have? Will it be square or rectangular? What sides will be the shortest?
3. Derive an equation for the *cost* of the cage as a function of the longer side.
4. Plot the cost function.
5. Use calculus to determine the dimensions of the cage with minimum cost.
6. Suppose the King decided that the unicorn’s cage would not have a gilded wall (thus making all sides of the cage cost 3 ducats per running cubit). Then what would be the dimensions of the optimally shaped cage?
7. What conclusions can you make?