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Introduction

What were the goals of this project?

- Use Gradient Descent to predict the shape of a bridge based on
- K-Values of rubber bands
- Masses at joints
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• What did you do?

- Created line of best fit from data of rubber bands that allows us to relate gravitational force and length stretched
- Gave us K and l0 for every rubber band
- Created cost function for bridge given mass at vertices and locations of vertices and k values of segments
- Used gradient descent optimization to find minimize potential energy and find theoretical positions of vertices by masses
- Compare gradient descent function output vs measured data

• What were the approaches or methods you used?

Methods

Unconstrained Optimization

Jungle Bridge Physical Model Characteristics [Table 1; Table 2; Table 3; Table 4; Figure 3]

Rubber Band Model [Figure 1, Figure 2]

- **Numerical Optimization Process (Gradient Descent)**
- **First Order Approximation - 17.7**
- **Backtracking line search**
- **Cost Function Derivation**
- **(Gravitational Potential Energy Function + Spring Pot Energy)**

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Constrained Optimization

Results

Linear Regression of Rubberband - Line of best fir for rubber bands (provides k and l0 values)

Ideal Bridge Config Results - Output of Generate Shape (most stable bridge)

Interpretation

Physics Rationale (Bridge wants to be at rest (least amt of pot energy))