# Llama Defense Systems: Simulating Herd Guarding Behavior

By Cassie Sterns and Jasey Chanders

**Problem and Significance:**

Llamas are commonly used as herd guards, much like sheep dogs, due to their natural protective instincts. They are particularly effective against predators such as coyotes, red foxes, wolves, and domestic dogs (Boham). Unlike sheep dogs, llamas require the same care as the livestock they protect and don't require training, making them a low-maintenance but reliable option for livestock protection. Understanding their defensive behavior is incredibly useful for mitigating herd losses in predator-prone areas. However, there is a lack of understanding and simulation of how llamas position themselves and respond to threats in different situations. Developing such a model can help optimize herd protection strategies and provide valuable insights for applying similar defensive principles in other scenarios.

**Background and Related Work:**

Llamas are well known for their ability to guard flocks of sheep, cattle, and goats and there is a reasonably large body of work studying their effectiveness. Much of what we know about using llamas as herd guards comes from research published by various agricultural departments at universities. Data such as llama to flock size ratios, effectiveness from differing types of threats and effectiveness of different group sizes of llamas can be collected from these studies. However, very little research appears to have gone into understanding their positioning during defensive behaviors. Thus much of our understanding of their guarding behaviors comes from anecdotal and video evidence from farmers who employ their services.

**Plan of Execution and Weekly Milestones:**

Week 1: Literature Review & Initial Modeling Concepts - Mar 14
- Conduct a literature review on llama behavior and herd dynamics
- Define the main elements of the defensive behavioral model
- Identify the important variables i.e. number of predators, number of llamas, size of flock etc.

Week 2: Model Framework Design - Mar 21
- Research and decide on the simulation platform
- Define the basic framework for the simulation and how agents (llamas, and sheep, threats) will interact
- Propose a basic model for how a single llama positions itself as a guardian in response to a single threat

Week 3: Single Llama Defense Simulation - April 4th
- Implement the model for a single llama protecting the herd.
- Run initial simulations to observe the effectiveness of the defensive behavior.

Week 4: Multiple Llamas in Defense Simulation - April 11th
- Expand the model to simulate multiple llamas working together to protect the herd.
- Test different scenarios to refine the coordination strategy.
- Prepare for presentation, including visualizing the simulation results

April 9th or 16th - Target presentation days

Week 5: Simulation Refinement & Testing - April 18th
- Test and refine the models in different situations (e.g. vary llama numbers, number of predators, proximity of predators).
- Analyze the defensive strategies in terms of effectiveness.
- Troubleshoot and adjust the model to ensure a best representation of behavior.

Week 6: Final Testing & Documentation - April 25th
- Perform final simulations
- Write the project documentation

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