**Description**

Implement causal inference on dynamic systems using the probabilistic programming language Omega, giving the ability to do inference and counterfactuals. We will do this by taking a set of ODEs/SDEs and simulating data using the Gillespie algorithm. To start we will implement the Lotka-Volterra predator-prey model. Ideally the function will be extended to intake any SBML and run simulations on the model. We need to implement Gillespie in a way that we can make interventions at any time during the simulation. Once the data is simulated we can make inferences and counterfactuals. We want to look into both inferring rates and species abundances. Omega should also allow us to make interventions at different time periods of the simulation.

Additionally, as a long shot goal, we would like to make comparisons between using probabilistic programming to using an SCM or other non-causal modeling methods. We would like to explore the exact benefits of using probabilistic programming.

**Deliverables**

1. Implement Gillespie in Julia
   1. **Deliverable**: Code
2. Simulate the Lotka-Volterra model using Gillespie
   1. **Deliverable**: plot of the trace
3. Implement the simulation in Omega
   1. **Deliverable:** Omega code
4. Run different inferences/counterfactuals using Omega
   1. **Deliverable:** Plots of interventions/counterfactuals
   2. Intervention Ideas
      1. Increased prey value
      2. Increase prey at certain time (t\_now)
      3. Treatment effects of culling prey vs increasing predators
5. Implement the ability to intake different SBMLs and ensure they work
   1. **Deliverable**: Function that takes SBML and simulates
6. Compare Omega model to other methods of analysis: SCMs, ect.