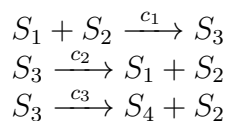


Exercise 3 - Chemical Langevin Equation

For all our exercises, we will consider the following system consisting of substrate S_1 , enzyme S_2 , complex S_3 and product S_4 :



It is often referred to as Michaelis Menten Kinetics and will serve as a manageable system to train techniques and algorithms from the lecture.

1. From τ -Leaping to the Chemical Langevin Equation (CLE) and beyond

For τ -Leaping, the number of triggered reactions is given by a Poisson random variable \mathcal{P} .

- What happens to a random variable \mathcal{P} that is Poisson-distributed with a very large mean (and equal variance)?
- How do you modify the τ -Leaping code in order to create a solver for the CLE?
- What do you observe when varying τ ?
- How could you further modify your code to solve the Reaction Rate Equation (RRE)?
- How does the solution look like for different numbers of traces and τ ?

2. An Overview

| | CME | Gillespie | τ -Leaping | CLE | RRE |
|-------------------------------------------|-----|-----------|-----------------|-----|-----|
| Overall accuracy | | | | | |
| Approximations (stacked) | | | | | |
| Quality of solution | | | | | |
| Conditions to control the error (stacked) | | | | | |
| Type of solution | | | | | |
| Algorithmic complexity | | | | | |