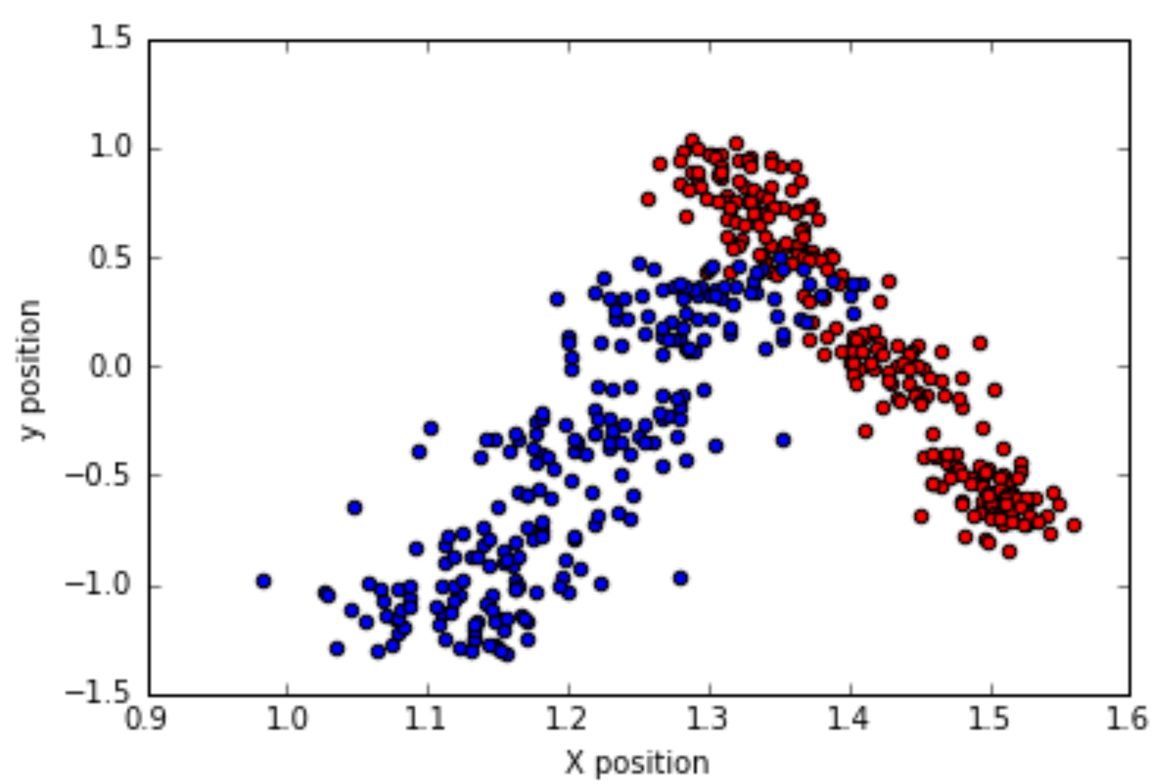
HW 8: Bayesian Inference

due Apr 19 @ 8pm

Inferring underlying properties of physical systems is a fairly ubiquitous requirement in data-driven fields. The following problem involves inferring the motion properties of two objects given (noisy, finite #) measurements over time.



the observed location data looks like:

	t	red_pos_X	red_pos_Y	blue_pos_X	blue_pos_Y
0	1.718397	1.330174	0.993564	1.081700	-1.295918
1	2.998056	1.310404	1.012772	1.004997	-1.254394
2	6.015073	1.270312	1.028386	1.113696	-1.321257
3	8.267651	1.331131	0.948223	1.001845	-1.285209
4	9.279321	1.346159	0.963485	1.113008	-1.261147

Assume both objects move at a fixed speed/direction, and assume that there is a fixed measurement error (ie., the observed location in **x**,**y** is the true location plus some i.i.d. Gaussian random noise at time ***t***).

Use PyMC and Bayesian inference to answer the following questions:

a) What is the posterior of the speed of each object?

b) What is the 5% and 95% confidence interval of the time range when the true Y value of the Blue object is => 0 AND the true Y value of Red <=0? That is, what are the 5% and 95% quantiles of the estimated *first time* when Y_blue >= 0 and Y_red <= 0?

c) If both objects are known to be moving at the same speed, how does you answer in a and b change? That is, that the total magnitude of the velocity (sqrt[$v_x^2 + v_y^2$]) is the same for each object.

d) Repeat your answers for a-c by using only the first 100 measurements? Do the changes make sense?