Lecture 28: Bayesian Inference

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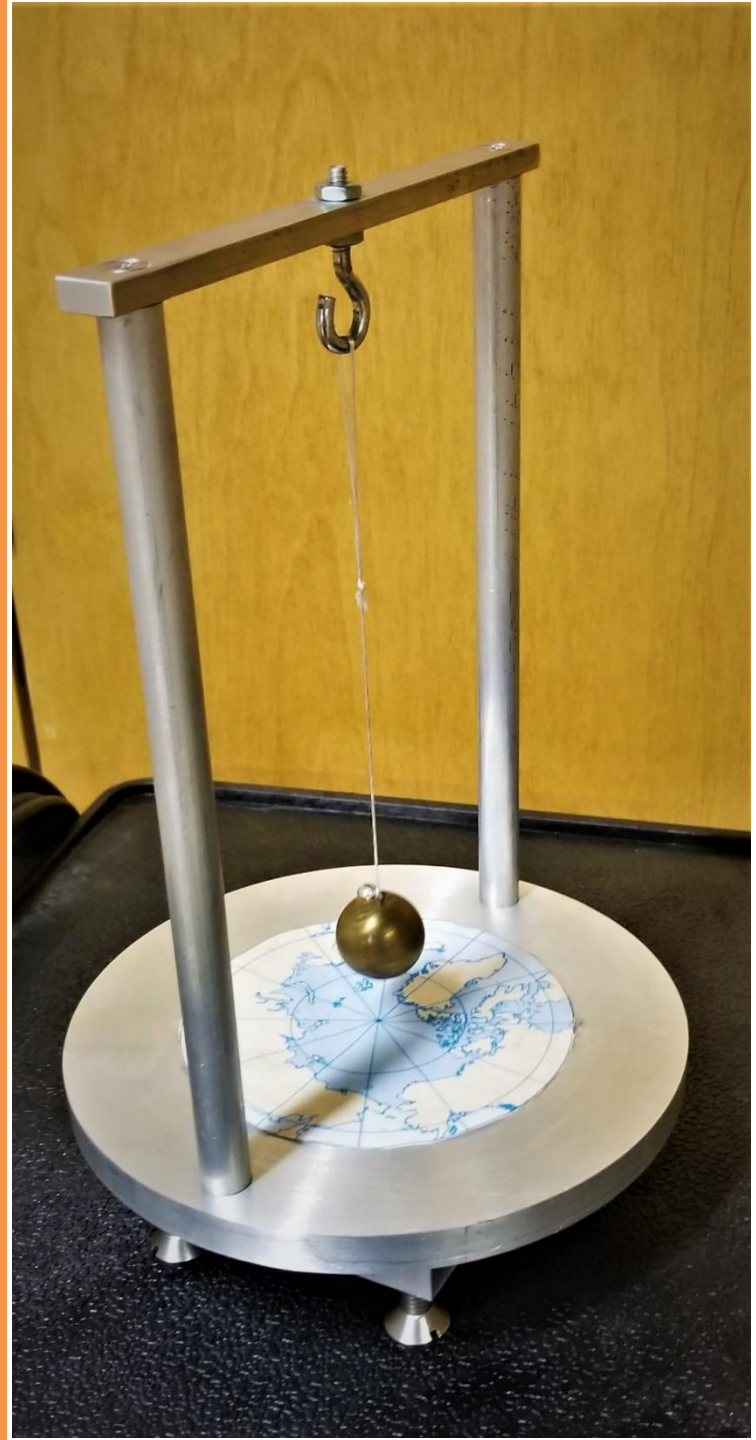
Least Square Fits

- We have some observational data
- And physical model expressed by formula
- All we have to do is to fit formula to the observations



Theory: For small angles, a simple pendulum follows a simple harmonic motion, where the period of a full swing back and forth (the time for one complete cycle) is given by the formula:

$T=2\pi\ Sqrt(L/g)$

- T is the period (time for one complete cycle, in seconds).
- L is the length of the pendulum
- g is the acceleration due to gravity (in $m/s2$).

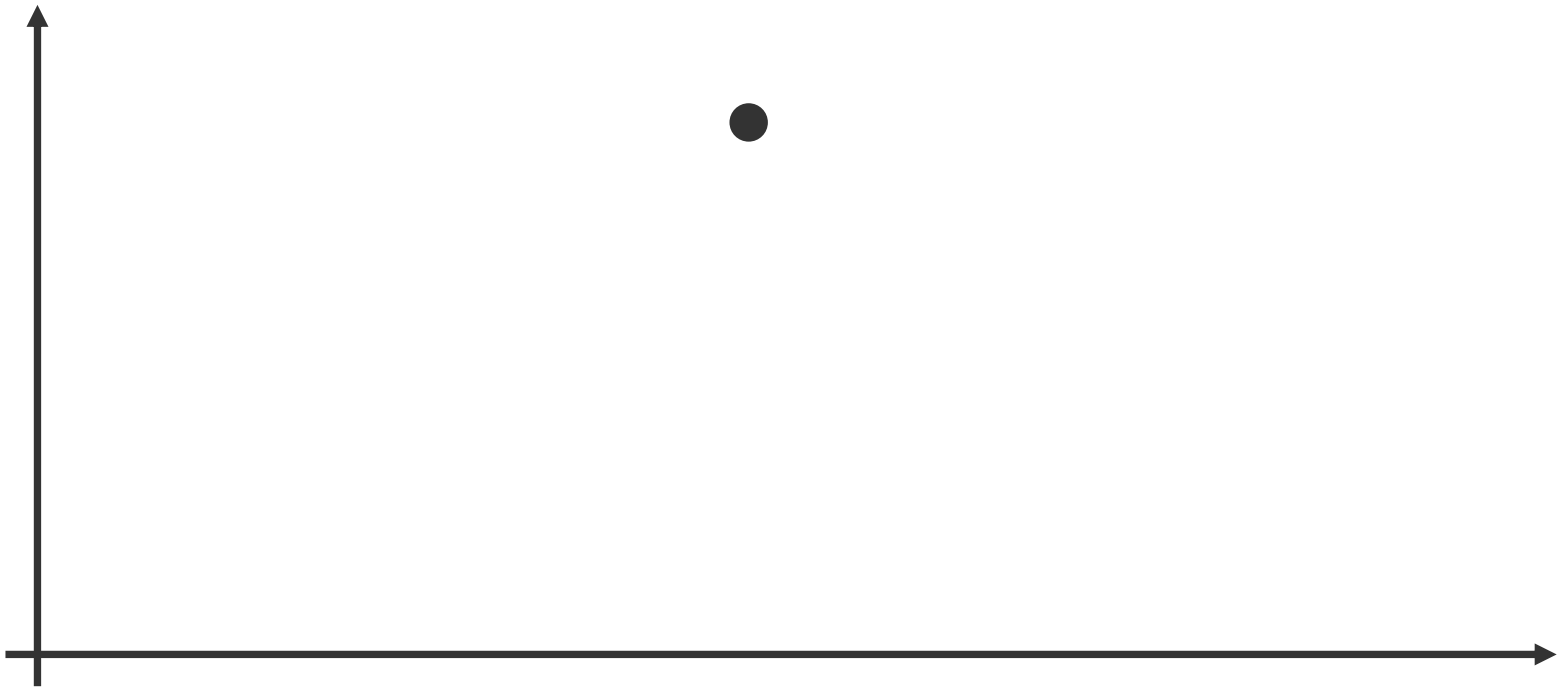
Procedure:

1. Measure the length of the pendulum (L) from the pivot point to the center of mass of the bob.
2. Displace the pendulum to a small angle (less than 15°) to ensure that the motion approximates simple harmonic motion and release it.
3. Use the stopwatch to measure the time it takes for the pendulum to complete a number of oscillations.
4. To reduce error, measure the time for multiple oscillations (say, 10 or 20) and then divide by the number of oscillations to find the average period (T).
5. Repeat a few times and average to minimize random errors.

Pendulum example

- Let's assume that we have a ruler, balance, and stop watch
- However, the measurements of g gives us 12 m/s^2. We know that the true value is 9.8 m/s^2
- How can we analyze the uncertainties?

Physics vs. data science



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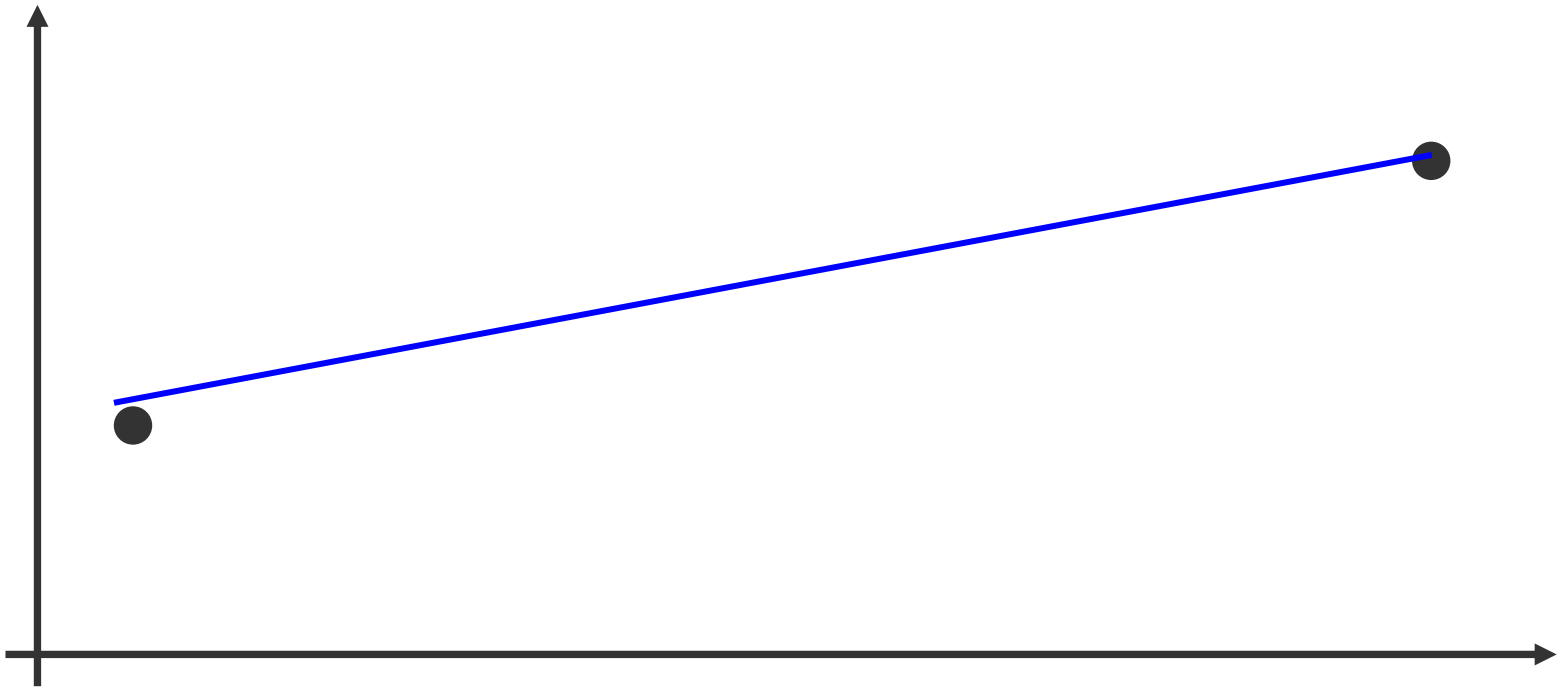

- If we have 2 data points, we “naturally” use linear model
- What should we use if we have three data points? Parabola or linear?
- What if we have one data point?

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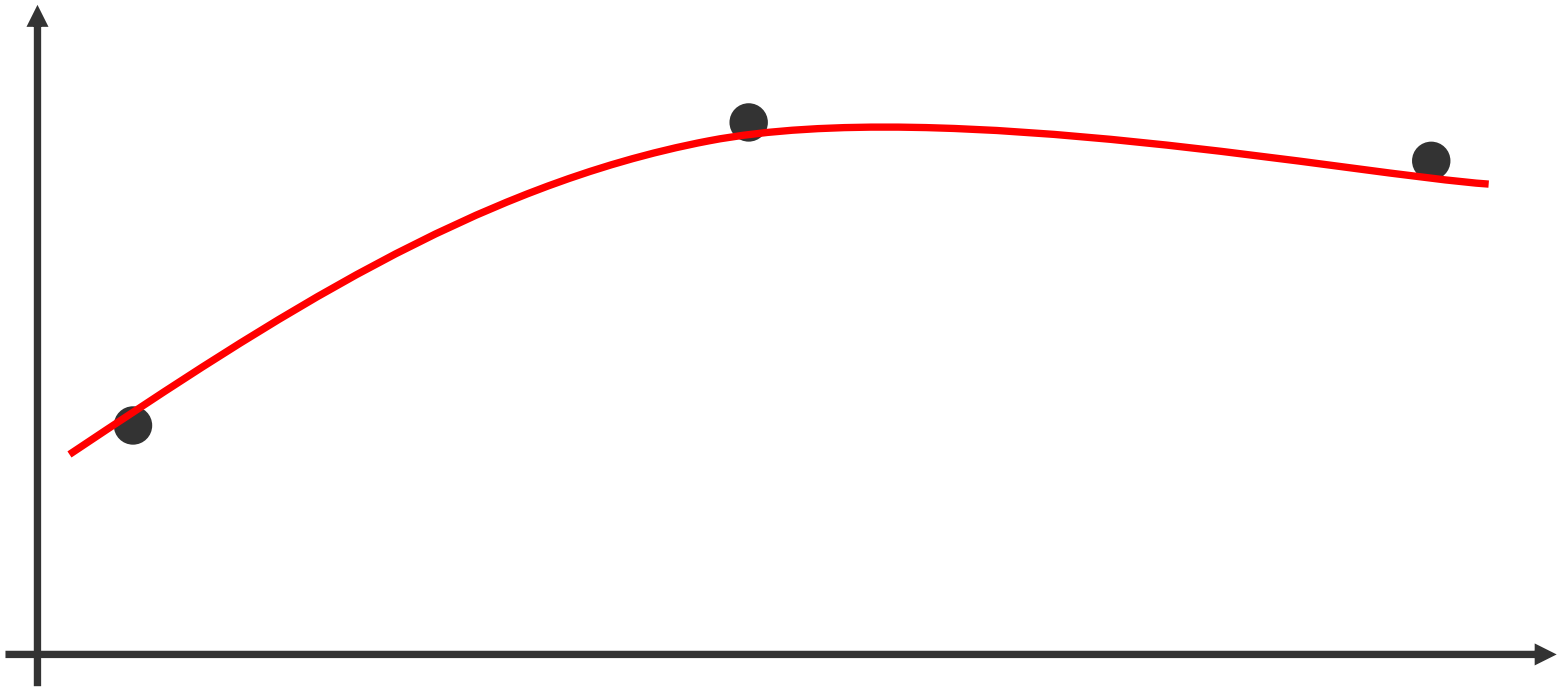

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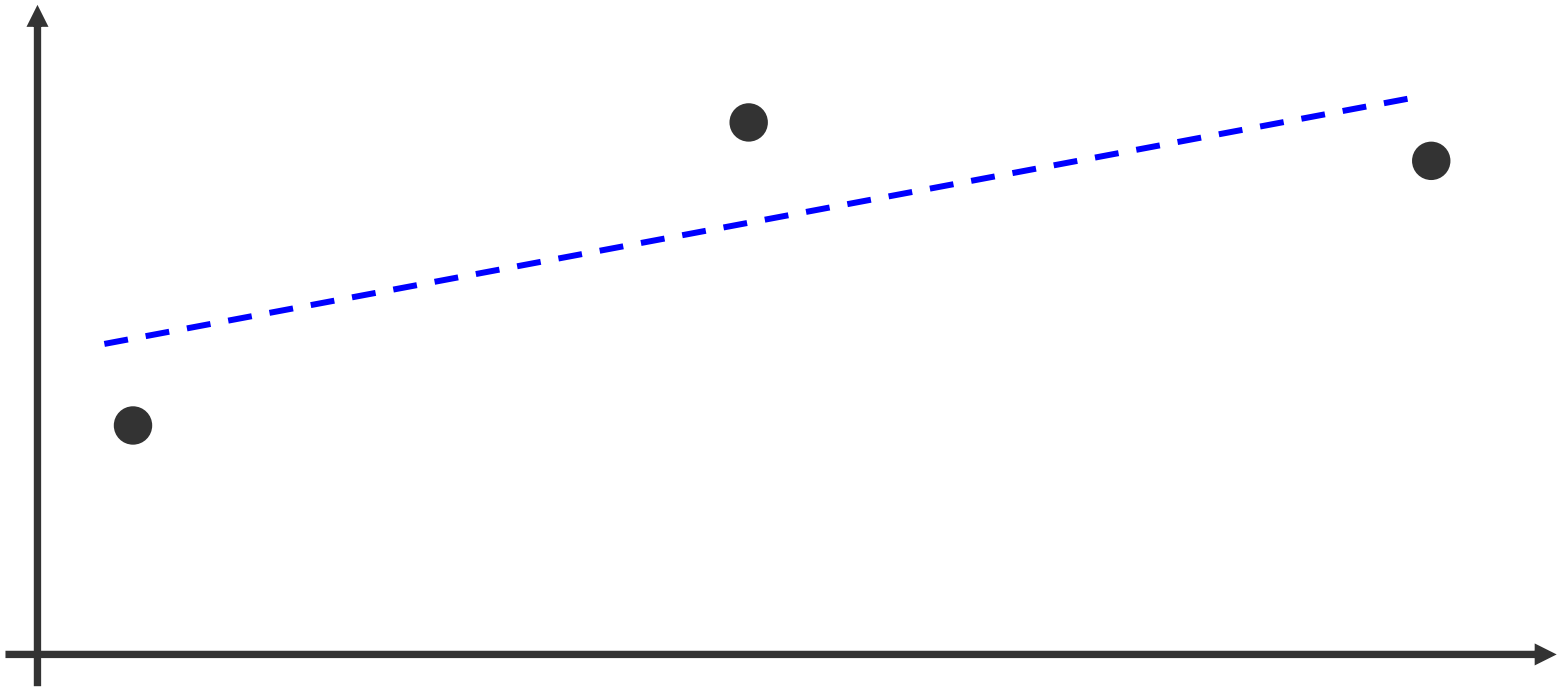

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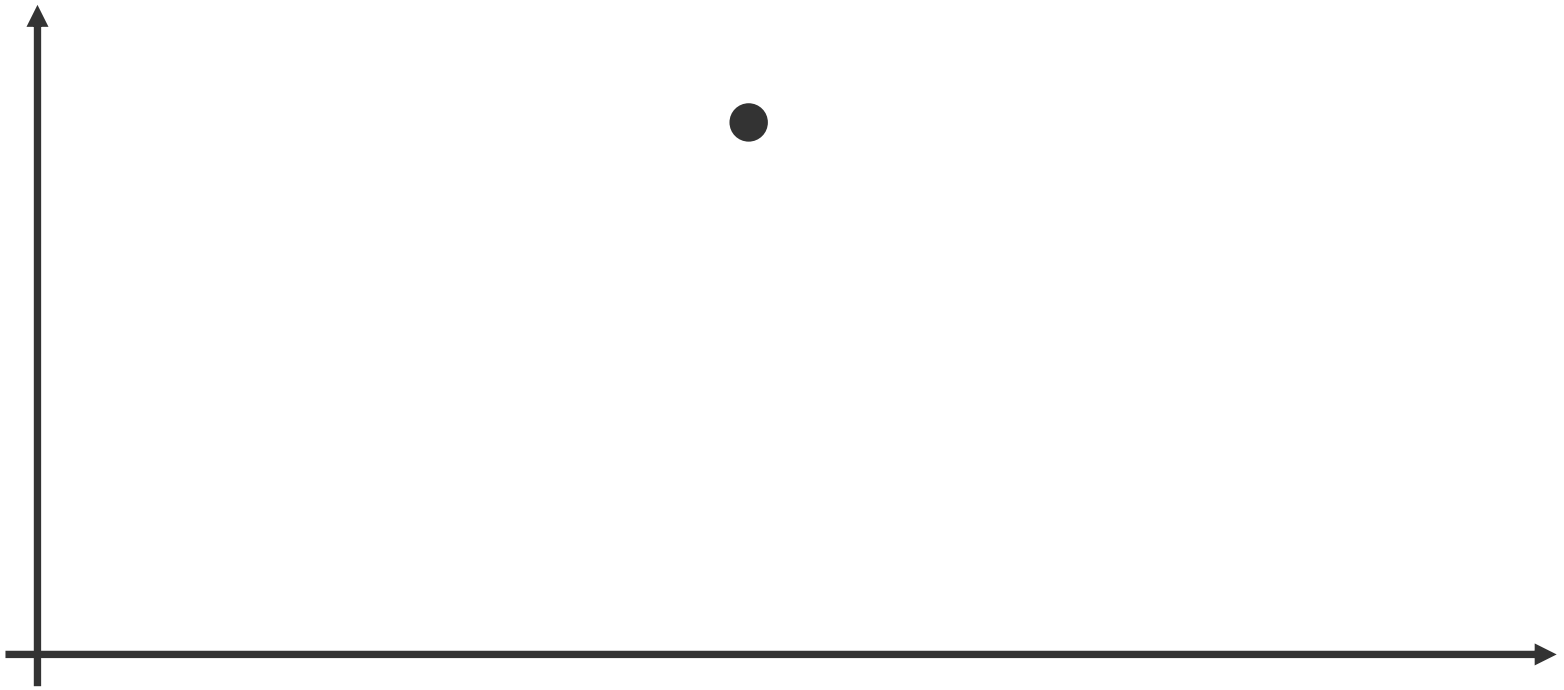

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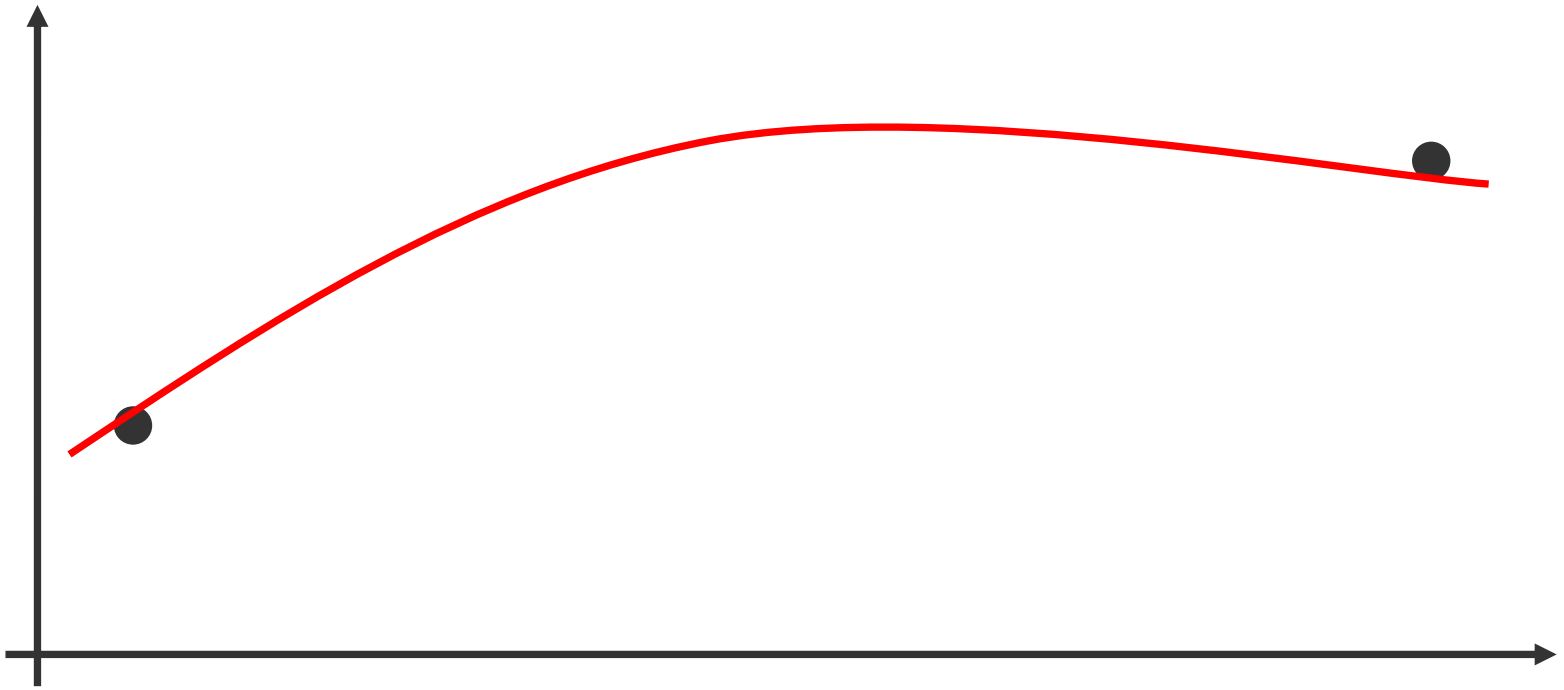

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