University of Basel

Bayesian workflow

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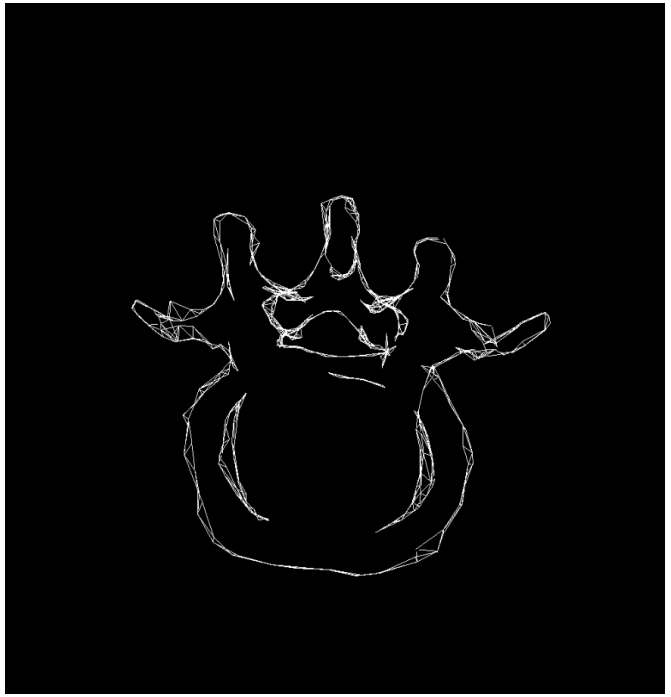
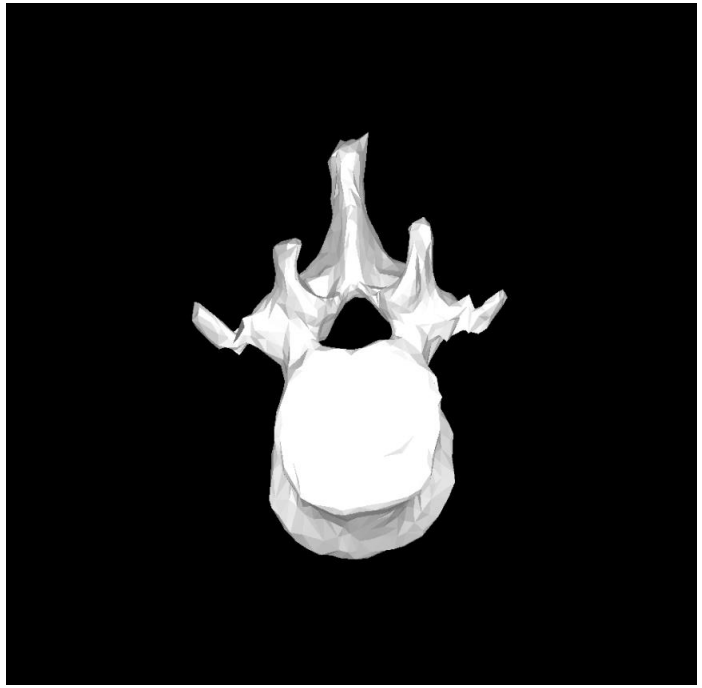
Why a Bayesian workflow?

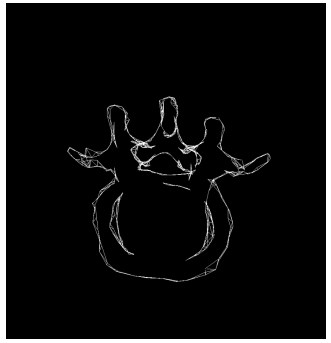


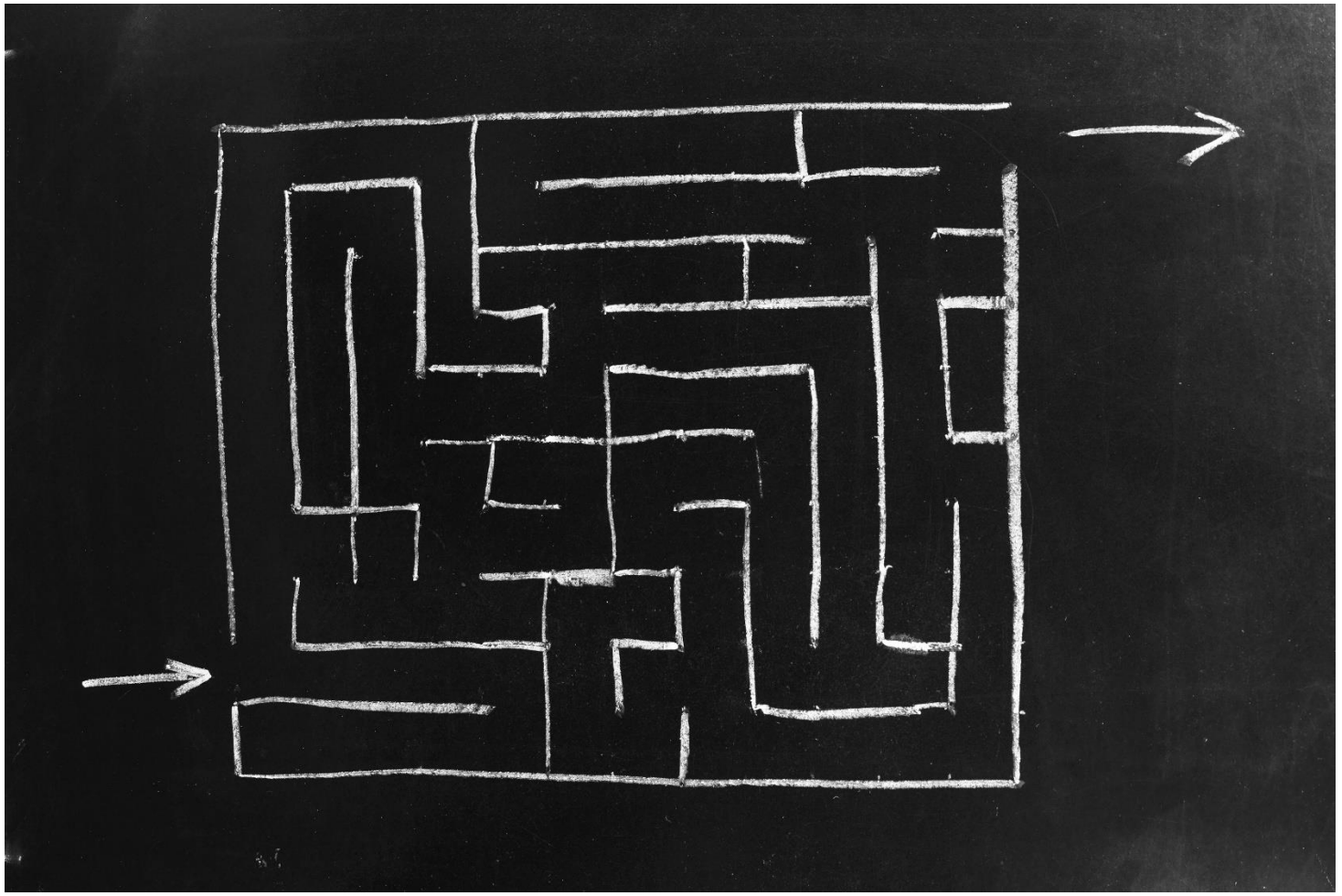
?

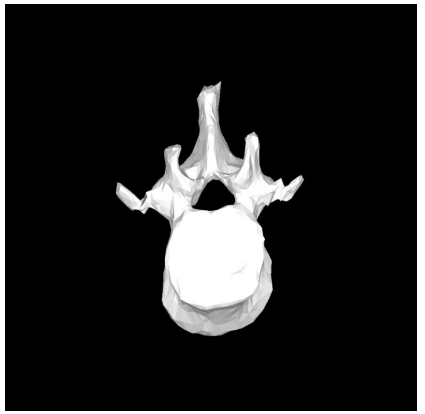
- What are the steps?
- How to start?



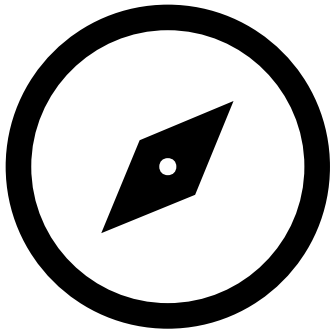
Why a Bayesian workflow?

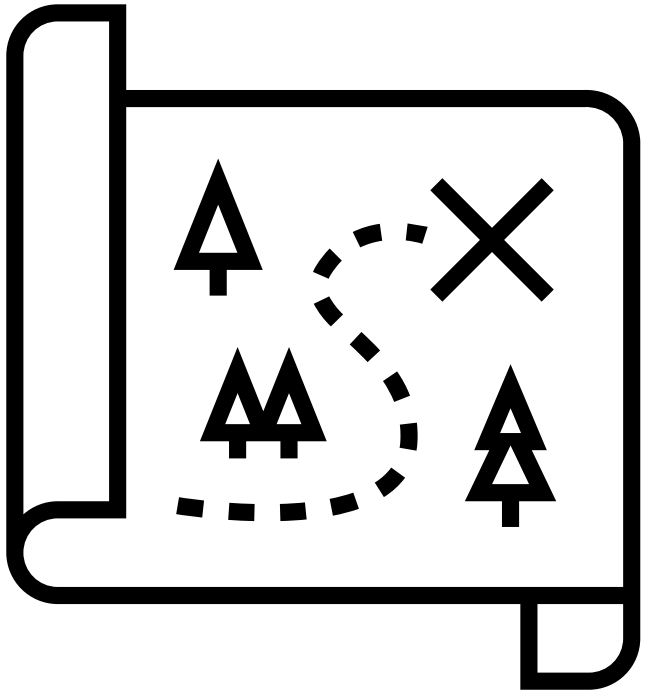






What is it?





Tools to navigate all your adventures in data analysis!

The workflow

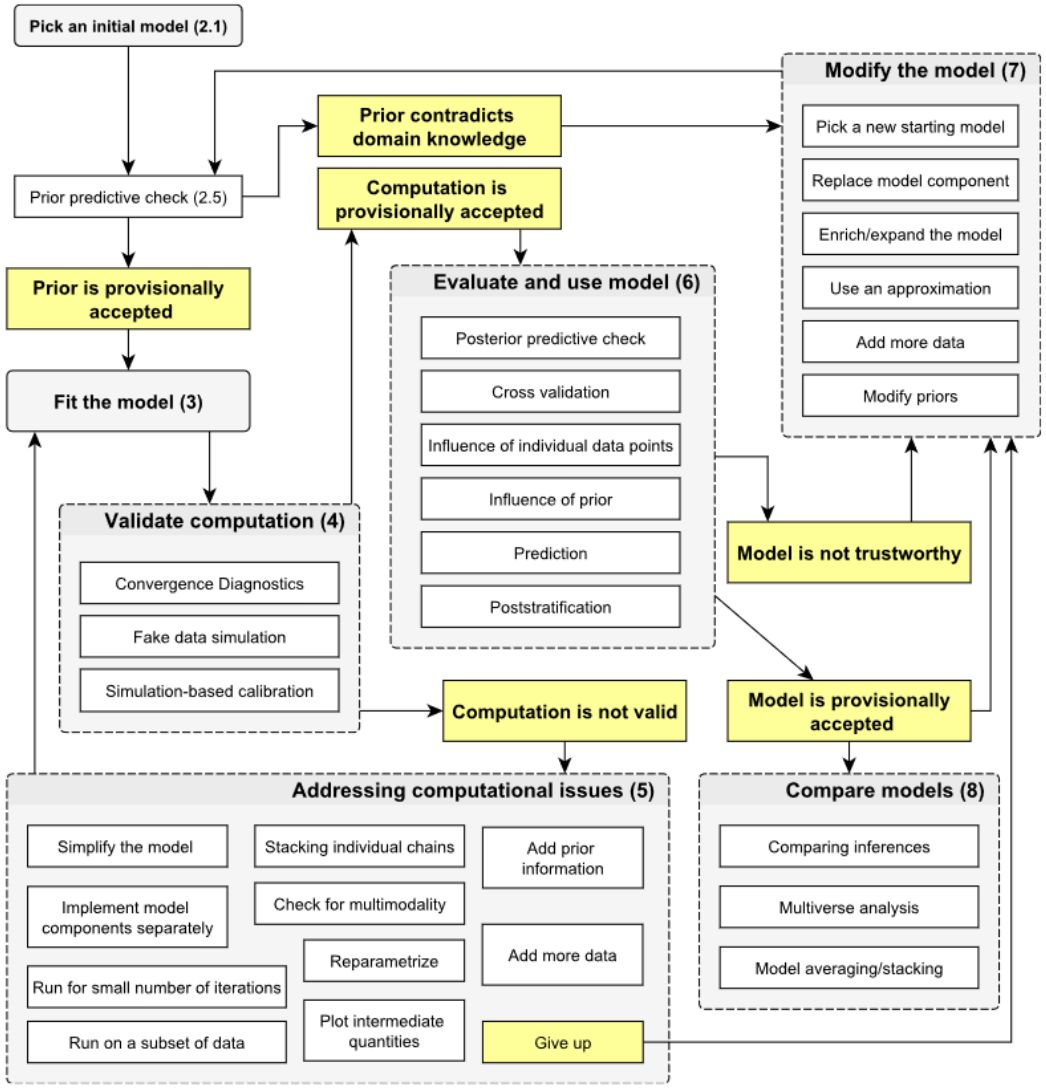


Illustration: Bayesian Workflow, Gelman et al.

Prior checks

- Does a model correspond to known domain knowledge (previous experiments, measurements, experience, …) ?

Computation

- Do the computations introduce bias or large approximation error?

Model evaluation

- Does the fitted model represent the original data?
- Can left out data be predicted?
- How much does our prior knowledge influence the result?

Model comparison

- Do other models work equally well, better?

Bayesian workflow in this course

Prior modelling and checks
- Modeling distribution over vertebra shapes
- 3D Shape visualizations
- Generation of 2D contours images

Computation
- Markov-Chain-Monte Carlo methods
- Fake-data simulations for checking computation

Model evaluation
- Visual assessment of generated contours and 3D reconstruction
- Posterior-predictive checks

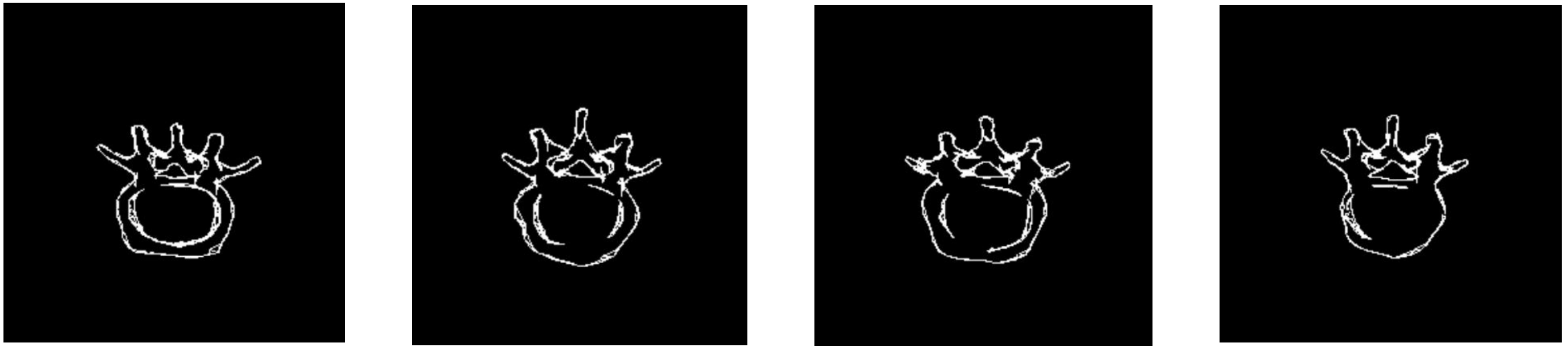
Model comparison
- More realistic modelling real-world scenarios (unknown sensor-distance, pose, missing data)

Walkthrough: Initial Model

Modelling shapes as normal distributions

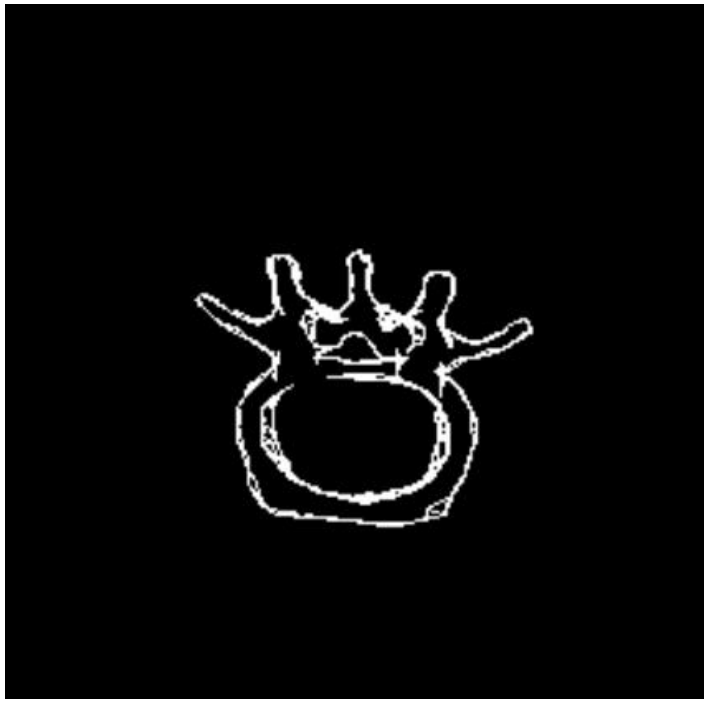
Walkthrough: Prior-predictive checks

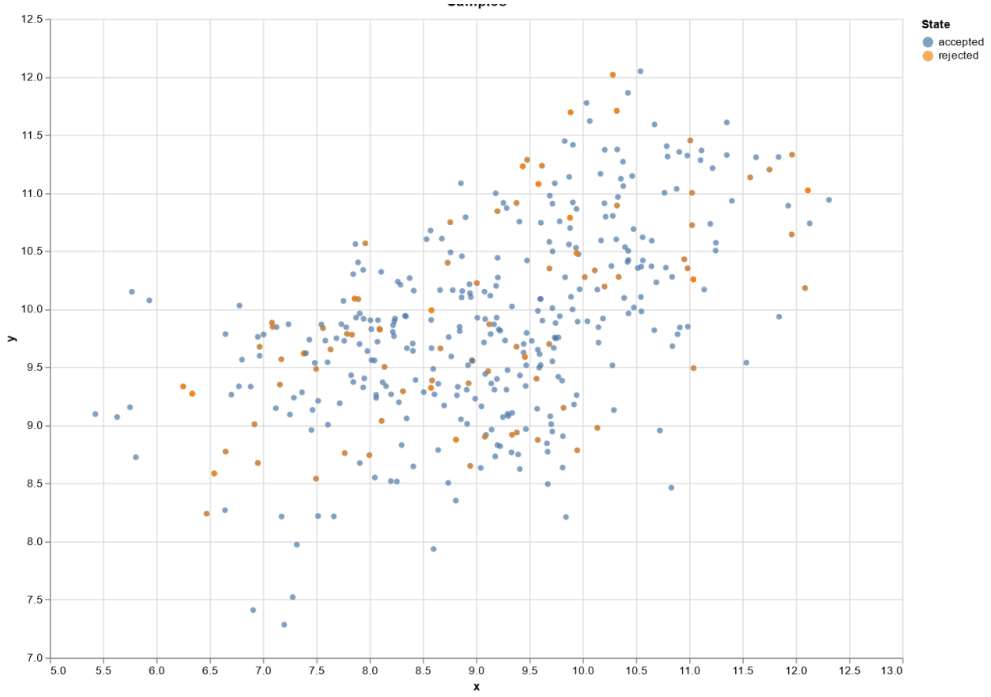
Sampled contours from the model



Walkthrough: Computation

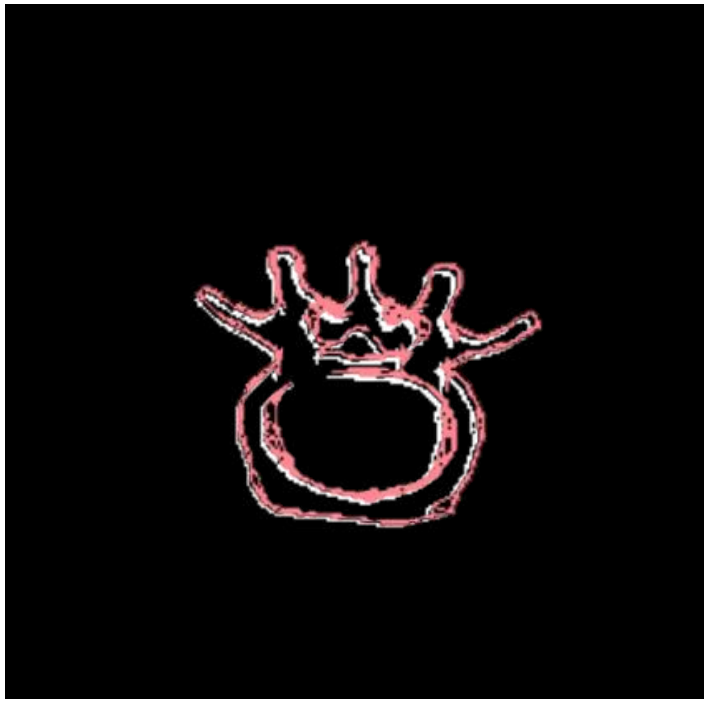
Running the Metropolis-Hastings algorithm on simulated data





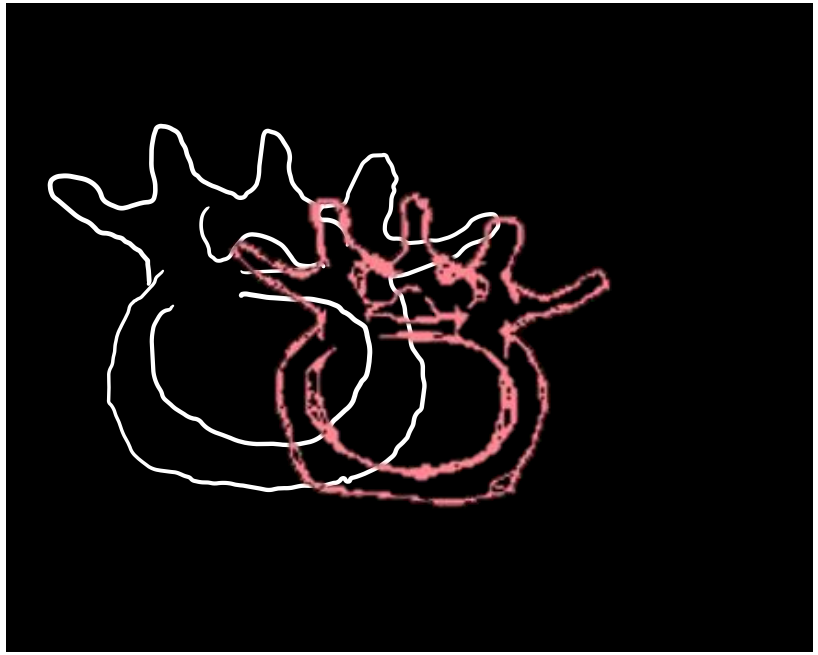
Walkthrough: Fake data simulation

Can we fit simulated contours from the generative model?

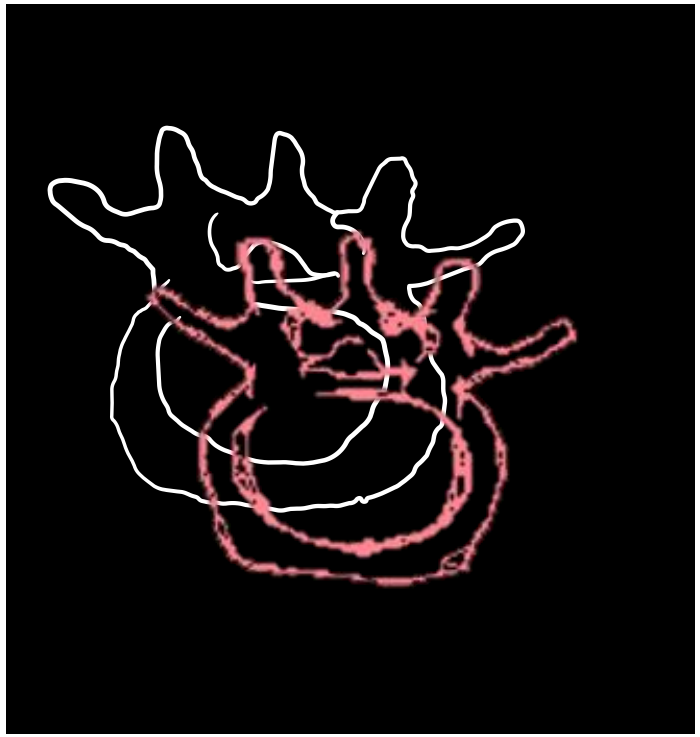


Posterior predictive checks

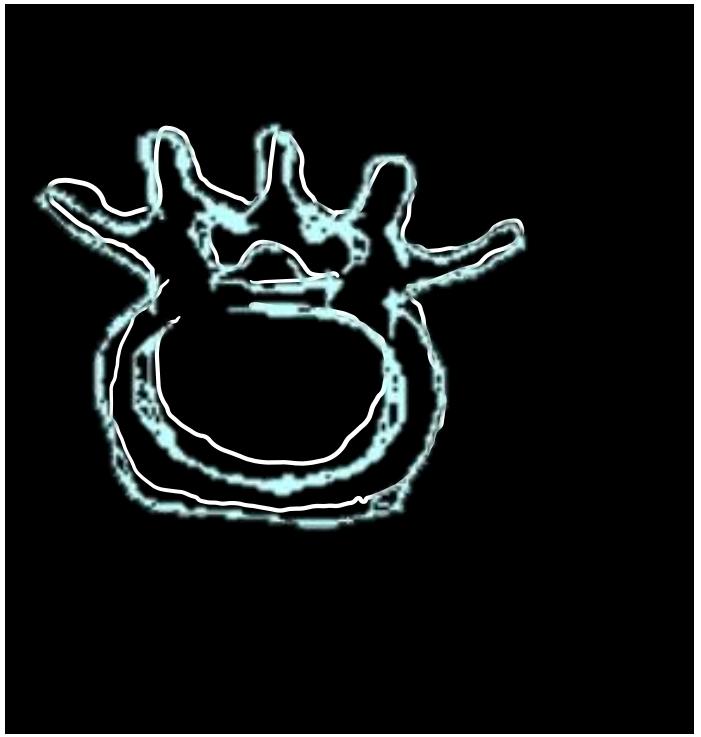
Is solution predictive of data we observed



Model comparison and improvement



Model of shape only



Model with pose and sensor-distance

Goal of the Bayesian workflow

Distribution of 3D shapes explaining the contour

- Understanding of the uncertainty
- Understanding of the limitations and capabilities
- Understanding of the influencing factors