Lithology/fluid prediction subsurface

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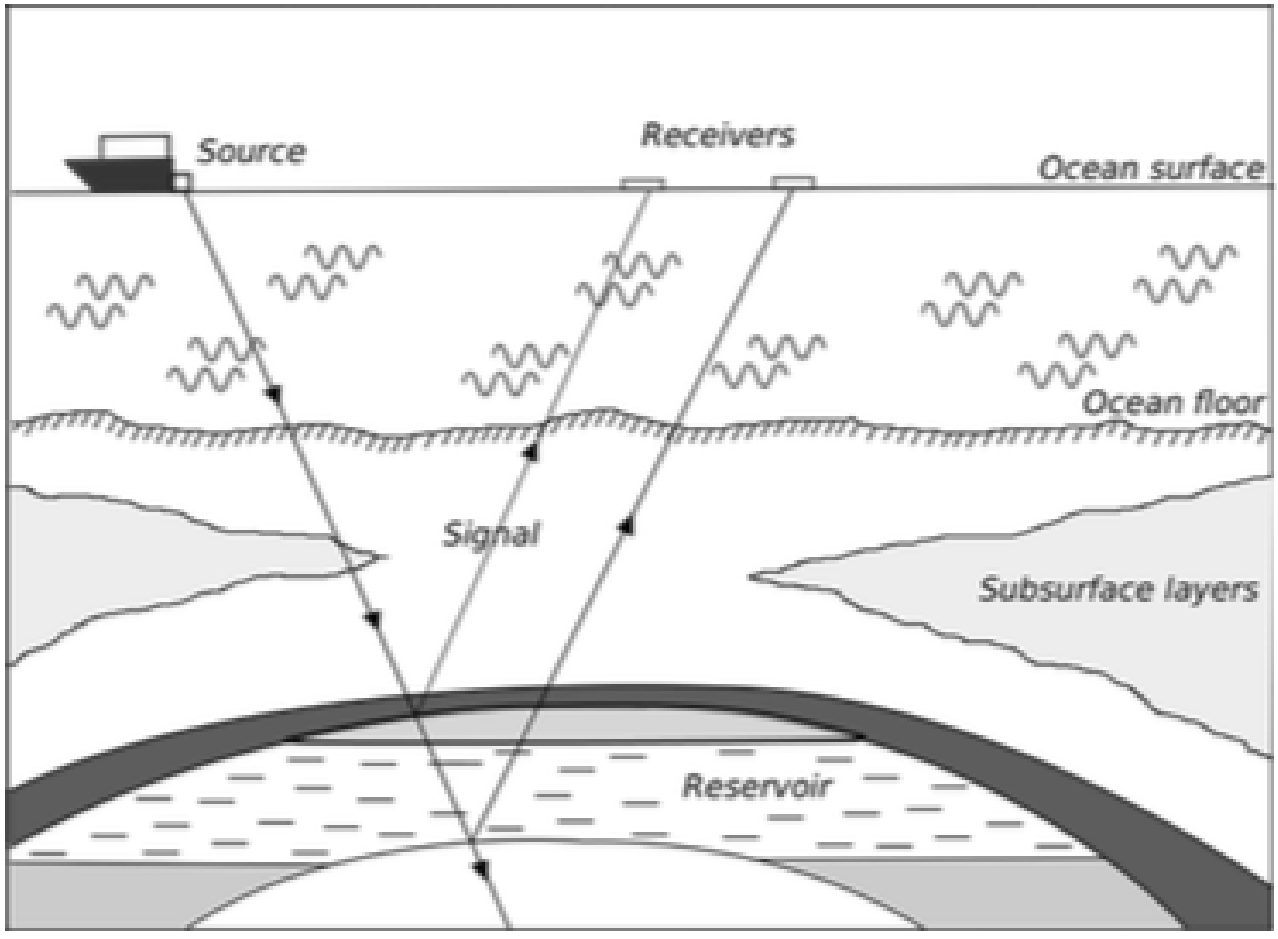

Source
Receivers
Ocean surface
Ocean floor
Signal
Subsurface layers
Reservoir

Observe (continuous-valued) convolved seismic reflections $(d_1, \ldots, d_n)$.

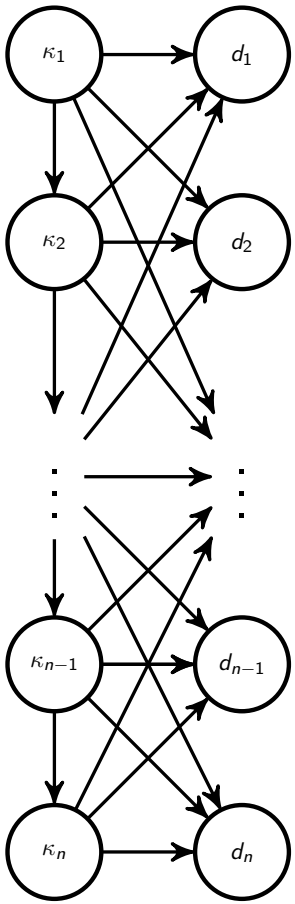
Variable of interest: $\kappa_t \in \{\text{sand-gas, sand-brine, shale}\}, t = 1, \ldots, n$

Posterior density of interest:

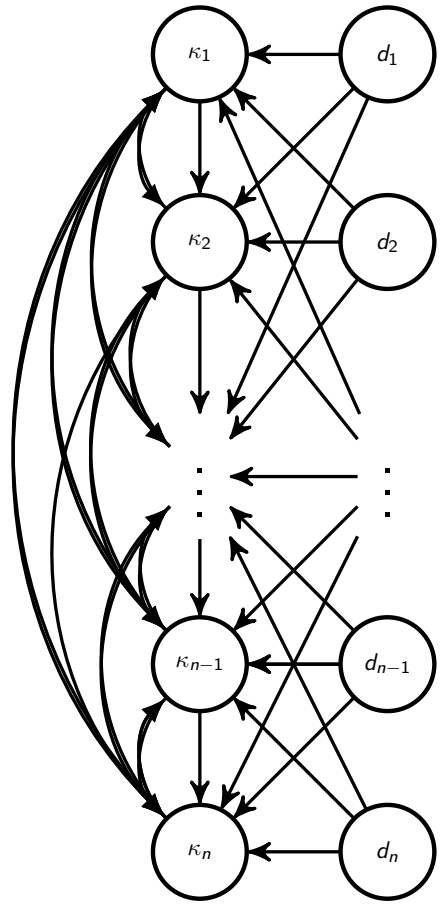
$$p(\boldsymbol{\kappa}|\,\mathbf{d}) = \text{const} \times p(\mathbf{d}|\,\boldsymbol{\kappa})\, p(\boldsymbol{\kappa})$$

Visualization of model in 1D

Convolved model:

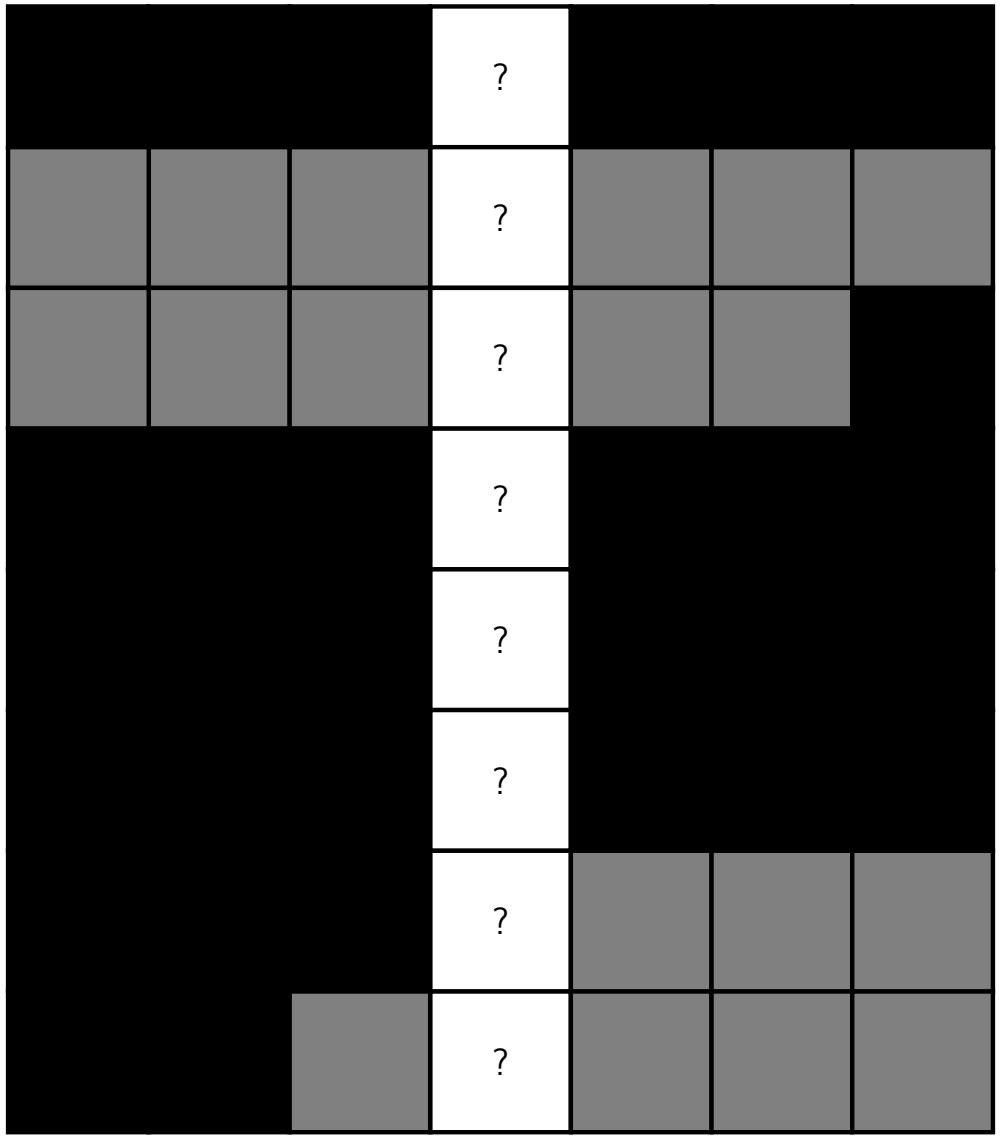


Inverse problem:



Markov random field prior model in 2D

Left neighbours Current trace Right neighbours



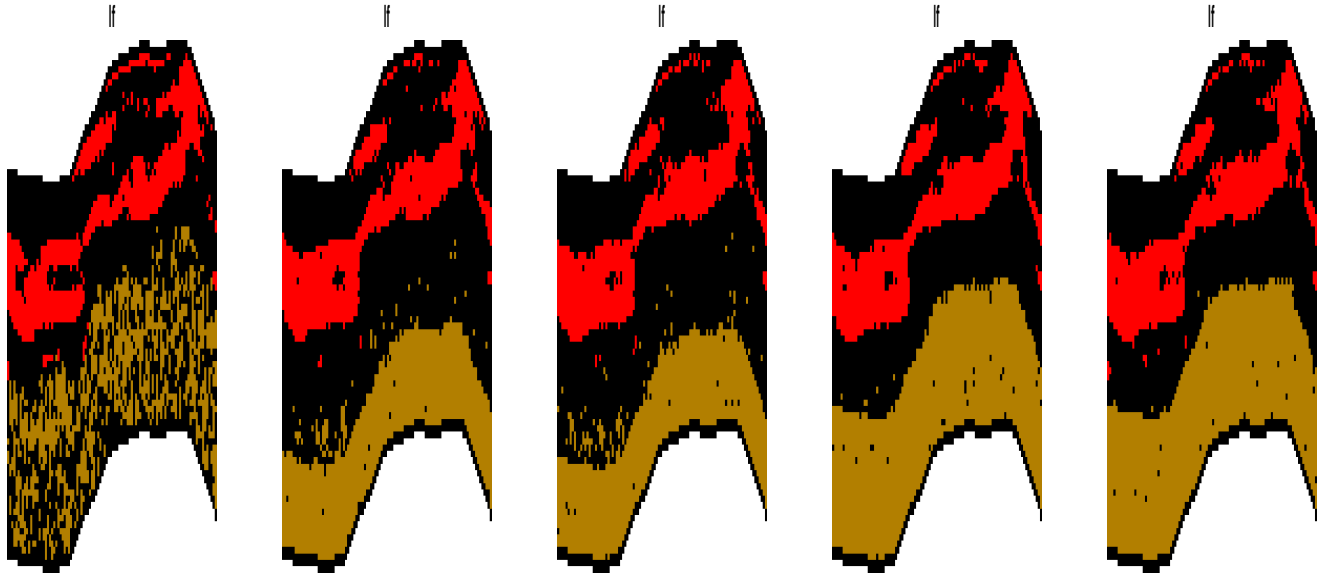
... the problem

We can not compute the normalizing constant in

$$p\left(\boldsymbol{\kappa}|\,\mathbf{d}\right) = \text{const} \times p\left(\mathbf{d}|\,\boldsymbol{\kappa}\right) p\left(\boldsymbol{\kappa}\right).$$

Assess by Markov chain Monte Carlo sampling.

Conditional realizations lithology/fluids



Extends to rock properties and elastic attributes